

We used scanning in earlier research as a way to show that when people do scan, they take longer to traverse greater distances – as expected if a depictive representation were processed. To our knowledge, no depictive researcher has ever claimed that scanning is *always* used to inspect images.

Critique 2: Assuming that images have a depictive format does not constrain the possible empirical phenomena.

Response: The issue is whether the properties that are intrinsic to depictions can be altered at will. Whereas one can describe an object without noting its orientation, one *must* include orientation in a depiction – even if orientation is a non-defining, incidental property. So too with size – a depiction (but not a description) *must* specify a visual angle, even if it serves no purpose in individuating the object. Theories that posit a depictive format make clear predictions that hinge on the geometric properties of the representation (such as the existence of the oblique effect in imagery – poorer acuity for diagonal sets of lines than vertical or horizontal).

Critique 3: Colors cannot be mixed in imagery; Emmert's law doesn't hold; and one cannot smoothly shift one's eyes to track a moving image.

Response: Imagery relies primarily on top-down perceptual processes, and thus depictive imagery representations need not affect low-level, bottom-up, processes such as those underlying color mixing, Emmert's law and smooth pursuit.

Conclusion

The closing parts of Pylyshyn's article offer a clear choice. One can attempt to work out a scientific theory, which guides empirical research and leads to new discoveries (as the depictive theory of visual images has), or one can argue that such efforts are a dead end and speculate that imagery is an ineffable phenomenon that cannot be illuminated by scientific research. We leave the choice up to the reader.

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Letters Response

Explaining mental imagery: now you see it, now you don't

Reply to Kosslyn *et al.*

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Kosslyn, Ganis and Thompson [1] take issue with several statements in my article [2], including my claim that imagery and vision are dissociable, that images are not *visually* reinterpreted, and that the pattern of cortical activity does not spatially (homeomorphically) map properties such as the size of imagined objects. Yet these claims are well documented, as the reader can verify by consulting [3]

and cited references. More important than these disputes is the misleading way, exemplified in the reply itself, that picture theorists appeal to a 'depictive' display in explaining mental imagery phenomena.

Explaining imagery

To explain experimental findings (such as the image scanning and size effects), picture theories assume that underlying the experienced image is a topographical pattern

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of activity on the surface of visual cortex that is interpreted by the visual system in roughly the way it might interpret a display (e.g. by scanning attention over it or 'zooming in' on details). But if one is to take this account seriously, one is owed an explanation for why the experimental findings from scanning mental images and reporting details from images of different 'size' disappear when observers do not think they would occur in the imagined situation, why imagery phenomena occur equally in depth as in the plane (and, indeed, why images are allocentric, 3-D, and panoramic when the assumed cortical display is retinotopic, 2-D and bounded), and why, if imagery and vision begin with the same patterns of neural activity, images fail to exhibit the many visual phenomena I enumerated.

To gratuitously add assumptions such as 'fading' or 'internal organization' whenever picture-theory predictions fail; to attribute to some 'larger system' effects occurring in depth that are identical to effects in 2-D; or to brush aside many disconfirming phenomena (e.g. Emmert's Law) on the grounds that they are 'low level,' whilst at the same time citing 'size,' 'oblique,' 'popout,' and similar low-level effects, is to replace the intuitive picture theory with a collection of ad hoc assumptions. The ruse of appealing to pictorial properties when convenient but then eschewing these properties when it is not, has been endemic to picture theories and belies any explanatory value they might otherwise appear to have.

Neuroscience evidence

The issue here is not whether topographically mapped areas of visual cortex are activated during imagery, but whether the *form* of this activation can explain the empirical phenomena without additional unconstrained ad hoc assumptions.

Alternatives

I suggested that many classical imagery phenomena are the result of observers doing precisely what the instruction to 'imagine' something asks them to do, namely to infer what they would see if they were to witness the event in question. This truism very naturally explains why people who do not

know about certain visual properties fail to report them in their 'image' (e.g. perspective foreshortening in the blind subjects cited by Kosslyn *et al.*) or why people do report certain visual properties (like edge junctions) when they are able to infer their presence in the imagined scene.

Nihilism

To attribute to me the view that science cannot discover the format of mental images is astonishing given that I have repeatedly argued the opposite [4,5] and have often discussed alternative formats [6–8]. What I did say is that any empirically adequate theory of mental imagery is unlikely to map directly onto our subjective experience (because, among other things, our experience is of the represented world and not of the form of the representation). Indeed, every attempt to build a causal cognitive theory based on subjective experience has been mired in contradictions. The case of mental imagery, as expounded by picture theorists, has been the most striking contemporary example of this phenomenological snare.

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